

OPTICAL RECORDING METHOD, OPTICAL RECORDING APPARATUS AND OPTICAL RECORDING MEDIUM

Patent number: EP0731454

Publication date: 1996-09-11

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Classification:

- International: G11B7/00; G11B7/095; G11B7/125

- European: G11B23/36, G11B7/00M2, G11B7/125L

Application number: EP19950932193 19950920

Priority number(s): WO1995JP01895 19950920; JP19940231215 19940927

Also published as:

WO9610250 (A1)
US5822287 (A1)
JP8096362 (A)
EP0731454 (A4)
EP0731454 (B1)

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more >>

Abstract of EP0731454

The intensity of an ultraviolet laser beam emitted from a UV laser beam source (1) is modulated based on additional information by an optical modulator (2), and directed to a mirror (14) through lenses (3, 4), a phase diffraction grating (5) and a half mirror (14). The laser beam is reflected from the mirror (14), focused by an objective lens (6) and then made to fall on an optical disc (8). Alternatively, an ultraviolet laser beam from a UV laser beam source (1) enters a phase diffraction grating through an optical modulator (2) and lenses (3, 4) and is divided into three beams by the phase diffraction grating (5). The three beams are applied to the optical disc (8) through a half mirror (11), a mirror (14) and an objective lens (6). Reflected light of visible laser beam from the optical disc (8) enters a half mirror (11), and is then reflected therefrom to enter an optical detector (13) through a cylindrical lens (12). The focusing control and tracking control are carried out on the basis of the output signal from this optical detector (13), whereby it is possible to form a spot of the ultraviolet laser beam in an accurate position in an additional information recording region and record the additional information thereon accurately.

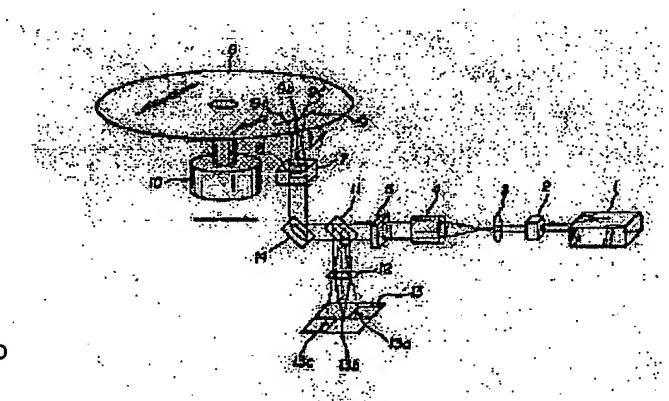


FIG.1

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(19)

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 731 454 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
28.03.2001 Bulletin 2001/13

(51) Int Cl.⁷: G11B 7/00, G11B 7/095,
G11B 7/125, G11B 23/28,
G11B 20/00, G11B 7/09

(21) Application number: 95932193.6

(86) International application number:
PCT/JP95/01895

(22) Date of filing: 20.09.1995

(87) International publication number:
WO 96/10250 (04.04.1996 Gazette 1996/15)

(54) OPTICAL RECORDING METHOD, OPTICAL RECORDING APPARATUS AND OPTICAL
RECORDING MEDIUM

OPTISCHES AUFZEICHNUNGSVERFAHREN, OPTISCHES AUFZEICHNUNGSGERÄT UND
OPTISCHES AUFZEICHNUNGSMEDIUM

PROCEDE, APPAREIL ET SUPPORT D'ENREGISTREMENT OPTIQUE

(84) Designated Contracting States:
DE FR GB

(56) References cited:
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EP-A- 0 542 730 DE-A- 4 403 171
DE-C- 4 321 799 JP-A- 1 260 642
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JP-A- 5 225 582 JP-A- 7 169 187
JP-A- 62 005 680 US-A- 5 325 348
US-A- 5 400 319

(30) Priority: 27.09.1994 JP 23121594

- PATENT ABSTRACTS OF JAPAN vol. 018, no.
417 (P-1781), 4 August 1994 & JP-A-06 124474
(VICTOR CO OF JAPAN LTD), 6 May 1994,
- DATABASE WPI Week 9125 Derwent
Publications Ltd., London, GB; AN 91-181953
XP002021740 & JP-A-03 110 193 (TOA GOSEI
CHEM IND LTD) , 10 May 1991

(43) Date of publication of application:
11.09.1996 Bulletin 1996/37

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Description**TECHNICAL FIELD**

5 [0001] This invention relates to an optical recording method for recording signals on a disc-shaped recording medium using a laser light beam, an optical recording device employing the optical recording method, and an optical recording medium on which signals have been recorded by the optical recording device.

BACKGROUND ART

10 [0002] Among the existing types of the disc-shaped optical recording media, there are a phase-change type optical disc and a magneto-optical disc as a write-once or overwrite (reversible) optical disc. Among recording light sources in optical recording devices employing these optical discs, there is known a semiconductor laser for recording signals on the optical disc and for erasing the recorded signals. The laser light beam radiated from the semiconductor laser may be converged on the optical disc as a small-sized spot with a diameter not larger than 1 μm.

15 [0003] Among replay-only optical discs, there is a CD-ROM employing a compact disc (CD) as a read-only memory. These CD-ROMs can be duplicated in large quantities. It is contemplated at present to record, on the replay-only optical discs capable of being duplicated in large quantities, such as CD-ROMs, information data for identifying these replay-only optical discs, for example, information data for discriminating whether or not the optical disc is an illicitly duplicated disc, in addition to the information signals, such as audio.

20 [0004] The laser light radiated by the semiconductor laser has a wavelength of 780 nm and is free from ablation. Thus it is not possible to produce a laser light output of an intensity capable of directly recording signals on the replay-only optical disc. Thus, if the identification information is to be recorded on the replay-only optical disc, it is not possible to minutely record the identification information on the replay-only optical disc using the semiconductor laser customarily used as the recording light source.

25 [0005] In view of the above-described status of the art, it is an object of the present invention to provide an optical recording method for recording the identification information proper to an optical medium on the recording medium and for reading out the identification information using an optical pickup configured for reading out the information signals recorded on the optical recording medium, an optical recording device for carrying out the optical recording method, and an optical recording medium having the subsidiary information recorded thereon by the optical recording device.

DISCLOSURE OF THE INVENTION

35 [0006] The object of the invention is achieved by the method of claim 1, the apparatus according to claim 13 and the medium according to claim 25. A method and a medium according to the preamble of claims 1 and 25 are known from EP-A-0 329 122.

[0007] The identification information is recorded in the subsidiary information recording area by modulating the UV laser light of a wavelength absorbed by the optical recording medium.

40 [0008] The wavelength of the UV laser light may be 190 to 370 nm.

[0009] The UV laser light may be the far-ultraviolet laser light generated by fourth harmonics generation by a neodymium YAG (Nd:YAG) laser, an Nd:YVO₄ laser, an Nd:YLF laser or a YAP laser.

[0010] The UV laser light may be a laser light from an Ar laser or a He-Cd laser.

45 [0011] The identification information may be recorded on the optical recording medium using a pre-recorded guide pattern for tracking.

[0012] If tracking is done using the guide pattern, the guide pattern may be detected using the light of a wavelength different from that of the laser light.

50 [0013] According to the present invention, since the identification information proper to each optical recording medium is recorded as the subsidiary information in the subsidiary information recording area, having the tracking guide pattern pre-recorded thereon, using the UV laser light, as tracking is done in accordance with the guide pattern with the aid of the light of a wavelength different from that of the UV laser light, the mass-produced optical recording media may be discriminated from one another.

BRIEF DESCRIPTION OF THE DRAWINGS

55 [0014] Fig.1 is a block diagram showing an illustrative construction of an optical recording device according to the present invention.

[0015] Fig.2 shows an illustrative arrangement of a UV laser light source constituting the optical recording device.

[0016] Fig.3 shows an illustrative recording state of the optical recording medium.

[0017] Fig.4 is a block diagram showing an illustrative construction of an optical recording/reproducing apparatus according to the present invention.

[0018] Fig.5 is a schematic cross-sectional view of an FZP employed in the optical recording/reproducing apparatus.

[0019] Fig.6 is a graph showing the relation between the diffraction efficiency and the phase depth in the FZP.

5 [0020] Fig.7 is a graph showing the relation between the aberration of the FZP before correction and that after correction.

[0021] Fig.8 is a schematic view showing the setting of a non-spherical surface in an objective lens of the optical recording/reproducing apparatus.

10 [0022] Figs.9A, 9B, 9C and 9D are graphs showing the residual wave surface aberration of the wavelength of 532 nm in an objective lens with a numerical aperture of 0.4 after correction with the FZP employed in the optical recording/reproducing apparatus.

BEST MODE FOR CARRYING OUT THE INVENTION

15 [0023] Referring to the drawings, preferred embodiments of the present invention will be explained in detail. Fig.1 shows, in a block diagram, an illustrative construction of an optical recording device embodying the present invention.

[0024] In the optical recording device of the illustrated embodiment, an ultra-violet laser light source 1, referred to hereinafter as a UV laser light source, capable of radiating a laser light beam of high energy density, is used as a signal recording light source. Specifically, the UV laser light source 1 is a light source radiating a far-ultraviolet laser light by employing generation of fourth harmonics of e.g., a neodymium YAG (Nd:YAG) laser. The light beam of the far-UV laser light and the visible laser light, radiated by the UV laser light source 1, is incident on a light modulator 2 by which the UV laser light is modulated in intensity by the subsidiary information which will be explained subsequently.

20 [0025] The UV laser light beam, modulated in intensity by the light modulator 2, is enlarged by lenses 3, 4 and passed through a phase diffraction lattice 5 so as to fall on a semi-transparent mirror or half-mirror 11. The UV laser light beam, transmitted through the half mirror 11, is reflected by a mirror 14 so as to be converged by an objective lens 6 mounted on a bi-axial actuator 7 so as to be radiated as a light spot on the surface of an optical disc 8.

25 [0026] The optical disc 8 is kept in rotation by a spindle motor 10 which is roughly positioned by e.g. screw feed along the radial direction of the optical disc 8.

[0027] The reflected light of the visible laser light from the surface of the optical disc 8 falls on the mirror 14 via the objective lens 6 so as to be reflected thereby to fall on the half-mirror 11. The reflected light incident on the half-mirror 11 is led to a photodetector 13 formed of silicon by a cylindrical lens 12 configured for detecting focusing error signals. The photodetector 13 detects the volume of the incident light and outputs electrical signals based upon the incident light volume. De-tracking signals from a guide groove for tracking 9 may be simultaneously detected using output signals from the photodetector 13.

30 [0028] Focusing error signals and tracking error signals may also be detected from the electrical signals outputted by the photodetector 13. These focusing error signals and tracking error signals are fed back to the biaxial actuator 7 for moving the actuator in a controlled manner so that the UV light spot radiated on the optical disc 8 is focused on the surface of the optical disc 8 at the same time as it is correctly positioned with respect to the guide groove for tracking 9.

[0029] The optical disc 8 has a resin substrate formed of light-transmitting materials, such as polycarbonate or acrylic resins. Thus the UV laser light radiated on the optical disc 8 needs to be a laser light beam appropriate for machining the polycarbonate or acrylic resin material. Since polycarbonate and acrylic resins absorb the light having the wavelengths of not more than 290 nm and the light having the wavelengths of not more than 370 nm, respectively, and the UV laser light having the wavelength of not more than 190 nm is absorbed by air, the UV laser light with the wavelength of 190 to 370 nm capable of being satisfactorily absorbed by the substrate of the optical disc 8 and being photodecomposed in a shorter time is preferably employed as the laser light for recording the subsidiary information on the optical disc 8. Thus, in the present embodiment, the subsidiary information is recorded using the UV laser light with the wavelength of 266 nm generated by the fourth harmonics generated by the neodymium YAG laser.

40 [0030] By this UV laser light, the subsidiary information is recorded as pits on the optical disc 8. Specifically, the portions of the disc irradiated with the UV light spot is removed by ablation for forming the pits.

[0031] The subsidiary information represents the identification information proper to the optical disc 8 and is comprised of micro-codes employed in coding or in a microprocessor. The contents of the subsidiary information include the information such as the serial number or pass-word of the optical disc 8.

45 [0032] The relation between the UV laser light and the size of the recorded pits is explained in detail. The size of the pit reproducible with a lens having a wavelength of 780 nm and the numerical aperture of 0.45 is not less than 0.87 μm. If pits are formed by recording on the optical disc 8 with the ablation mode at a sweep velocity of 1 to 4 m/sec, using the UV laser light, with a wavelength of 266 nm, modulated with a high speed with a pulse width of 20 to 200 ns, and a lens having a numerical aperture of 0.4 or less, the size of the pit thus formed by recording is substantially coincident with the size of the pit reproducible with the UV laser light of the wavelength of 780 nm and with the lens

having the numerical aperture of 0.45.

[0033] For detecting the focusing error signals and tracking error signals using the reflected light from the optical disc 8, the visible laser light with a wavelength of 532 nm generated by the UV laser light source 1 is used simultaneously with a UV laser light beam of a wavelength of 266 nm employed for pit recording in consideration of sensitivity, reaction and light-induced damage of the silicon photodetector 13.

[0034] The depth of the tracking guide groove 9 is set to one quarter of the wavelength of 532 nm of the laser light beam so that maximum signal modulation factor will be obtained for the laser light having the wavelength of 532 nm. The depth of the tracking guide groove 9 then becomes equal to one-half the wavelength of 266 nm, so that the signal modulation factor is minimized.

10 [0035] The detection of tracking error signal in the tracking operation is explained.

[0036] For detecting the tracking errors, a three-beam method is used. The three beams in the three-beam method are generated by the phase diffraction lattice 5. Thus a synthetic quartz having a high transmission factor of e.g., not lower than 90% for the UV light having the wavelength of 266 nm is employed as a material for the phase diffraction lattice 5. The phase depth of the phase diffraction lattice 5 is set to one-half the wavelength of 532 nm of the laser light so that the UV laser light with the wavelength of 266 nm will be transmitted through the lattice 5 and so that the diffraction efficiency will become maximum for the laser light beam with the wavelength of 532 nm. If the scattering caused by the synthetic quartz is disregarded, the phase depth corresponds to one wavelength for the wavelength of the laser light of 266 nm, thus minimizing the diffraction efficiency.

20 [0037] Although scattering by the synthetic quartz cannot in effect be disregarded, more importance is attached to the minimum diffraction efficiency for the wavelength of 266 nm. It is noted that synthetic quartz needs to be employed not only for the phase diffraction lattice 5 but also for the optical components employed in the optical system excepting a mirror.

25 [0038] The visible laser light, with a wavelength of 532 nm, radiated from the UV laser light source 1, is converted by the phase diffraction lattice 5 into three beams which are then radiated as spots 9a, 9b and 9c on the tracking guide groove 9 formed in the optical disc 8. The reflected light of the visible laser light, radiated as the spots 9a, 9b and 9c, falls on the photodetector 13 as spots 13a, 13b and 13c and the light volumes of the spots 13a, 13b and 13c are detected by the photodetector 13. Although the existing photodetector is not appropriate for promptly detecting the reflected UV laser light from the optical recording medium, focusing and tracking error signals can be detected speedily and accurately with the present optical recording device employing the visible laser light.

30 [0039] Meanwhile, by arranging a pair of four-quadrant photodetectors in register with the light spots 13a, 13c on the photodetector 13 associated with the light spots 9a, 9c formed by the ± 1 st order diffracted light, it becomes possible to simultaneously detect focusing error signals and tracking error signal by the astigmatic method employing a cylindrical lens and by the three-beam method, respectively.

35 [0040] That is, although the existing photodetector is not appropriate for speedily detecting the reflected UV laser light from the optical recording medium, the focusing and tracking error signals can be detected speedily and accurately with the present optical recording device employing the visible laser light. In other words, the subsidiary information can be recorded correctly by recording the subsidiary information, with the aid of the UV laser light beam, as focusing control and tracking control are applied with the aid of the visible laser light.

40 [0041] Referring to Fig.2, the UV laser light source 1 is explained in detail.

[0042] A laser diode 21 is a semiconductor laser radiating the laser light of a wavelength of 808 nm for exciting the neodymium YAG laser. The laser light from the laser diode 21 falls on an external resonator of the neodymium YAG laser. That is, the laser light falls on a crystal of the neodymium YAG laser 23, as a laser medium, via an optical fiber and a mirror 22, for exciting the neodymium-YAG crystal 23. Thus the excited light of the neodymium YAG laser with a wavelength of 1064 nm is radiated from the neodymium-YAG crystal 23.

45 [0043] The produced second harmonics laser light falls on a non-linear optical crystal element 24 of KTP ($KTiOPO_4$) within an external resonator for generating second harmonics (SHG). The laser light of the second harmonics, with a wavelength of 532 nm, generated by SHG, is transmitted through a mirror 25 to fall on an electro-optical modulation (EOM) element 26. The EOM element 26 is employed for high-speed phase modulation of the fourth harmonics laser light, radiated by the UV laser light source, based upon a signal from a signal source 33.

50 [0044] The second harmonics laser light from the EOM element 26 falls on an external resonator constituted by mirrors 27, 28 and a non-linear optical crystal element 29 composed of BBO. That is, the second harmonics laser light falls via the mirror 27 on a non-linear optical crystal element 29 via the mirror 27 to generate fourth harmonics laser light with a wavelength of 266 nm by way of fourth harmonics generation. The fourth harmonics laser light is radiated to outside via the mirror 28.

55 [0045] Since the UV laser light with the wavelength of 266 nm is excited continuously, light intensity modulation may be executed speedily. In addition, since the mode is high in uniformity, the laser light may be condensed easily to a spot with a diameter of not more than 1 μ m.

[0046] The resonant frequency of the external resonator can be swept by driving the mirror in a controlled manner

by a voice coil motor 30. That is, the external resonator is excited into operation at a pre-set frequency in a stabilized state. Specifically, the second harmonics laser light outgoing from the EOM element 26 and reflected light by the mirror 27 is incident on a photodetector 32. The photodetector 32 then converts the incident reflected light into an electrical current which is supplied to a lock circuit 31. The lock circuit 31 detects the position of the mirror 27, based upon the electrical current, and negatively feeds back the position signal of the mirror 27 to the voice coil motor (VCM) 30. The voice coil motor 30 controls the position of the mirror 27, using the position signal transmitted thereto, for locking the resonant frequency of the external resonator. Detailed description of the lock circuit is found in JP Patent Kokai Publication HEI-05-243661 corresponding to US Patent 5367531.

[0047] An illustrative example of the recording state of the subsidiary information by the optical disc is shown in Fig. 3.

[0048] Information signals, such as audio, video and data, are recorded in the information recording area 50 on the optical disc 8. On the inner peripheral side of the information recording area 50, there is provided a lead-in area as an area for recording the information specifying the contents of the information recorded in the information recording area 50. A subsidiary information recording area 51 for recording the subsidiary information is provided in the lead-in area, and the identification information proper to the optical disc is recorded in the subsidiary information recording area 51.

[0049] The subsidiary information recording area 51 need not be in the lead-in area and may be in any other area provided that a guide groove for tracking is formed therein. That is, the guide groove for tracking serves as a guide for writing the identification information on the disc.

[0050] The information signals recorded on the optical disc 8 are read out using an optical pickup employing a laser light source such as a semiconductor laser other than the near-infrared laser. The recorded subsidiary information may be reproduced using an optical pickup configured for reproducing the information signals. The read-out signals of the subsidiary information, made up of micro-codes, directly enters a micro-processor, not shown, for discriminating the contents of the information for directly identifying the optical disc.

[0051] The optical disc is mass-produced using a stamper. Specifically, a photoresist film is coated on a glass plate, and signals are recorded thereon by laser light and developed to prepare a master disc. A metal mold (stamper) is then fabricated using the master disc. The optical disc, having the information signals recorded thereon, may be produced in large quantities using this stamper. On the surface of the optical disc carrying the recorded information signals, a metal film for reflection is deposited by vacuum deposition and a protective layer of hard resin is formed thereon to complete a duplicated optical disc.

[0052] The step of recording the subsidiary information on the optical disc using the far-UV laser light radiated from the UV laser light source 1 is carried out before the step of vacuum deposition of the metal film in the above-described method for producing the optical disc.

[0053] In the above-described embodiment, an Nd:YAG laser capable of radiating the laser light with a wavelength of 266 nm by fourth harmonics generation from the laser light with a wavelength of 1064 nm is employed as the UV laser light source. As alternative solid lasers, use may be made of an Nd:YVO₄ radiating the laser light by fourth harmonics generation of the wavelength of 266 nm from the laser light of the wavelength of 1064 nm, an Nd:YLF radiating the laser light by fourth harmonics generation of the wavelength of 262 nm from the laser light of the wavelength of 1047 nm and an Nd:YAP radiating the laser light by fourth harmonics generation of the wavelength of 270 nm from the laser light of the wavelength of 1079 nm. Alternatively, as the semiconductor laser light source capable of directly radiating a quadrupled wave, an AlGaAs laser source capable of radiating laser light having the wavelength of 0.78 to 0.86 μm or an InGaAs laser source capable of radiating the laser light having the wavelength of 0.9 to 1.1 μm may be employed. It is also possible to use a laser light from a gas laser source, such as an Ar laser source capable of radiating laser light of the wavelengths of 0.275 μm, 0.306 μm, 0.333 μm, 0.351 μm or 0.364 μm, or a He-Cd laser capable of radiating laser light having the wavelengths of 0.325 μm or 0.354 μm.

[0054] Although KTP or BBO (β -BaB₂O₄) is used in the above-described embodiment as the non-linear optical crystal element, LN, QPM, LN, LBO or KN may also be employed.

[0055] In addition, although the three-beam method is employed in the above-described embodiment for detecting focusing and tracking, it is possible to use a skew beam method or a push-pull method for detecting focusing or tracking, respectively.

[0056] The optical recording apparatus according to the present invention is now explained.

[0057] The optical recording apparatus includes a UV light source 1, an optical pickup 40 for radiating a light beam outgoing from the UV laser light source 1 on the optical disc 8 and transmitting the reflected light from the optical disc 8 to a photodetector 45, and a servo circuit 47 for effecting servo control based upon output signal of the photodetector 45, as shown in Fig.4. The parts or components which are the same as those shown in Fig.1 are depicted by the same reference numerals, and the corresponding description is omitted for simplicity.

[0058] The UV laser light source 1 radiates a far-UV laser light in a waveform range of from 200 to 300 nm and a laser light in the visible waveform range of from 400 to 700 nm. The laser light of the far-ultraviolet (far-UV) range is set to a wavelength equal to one-half that of the visible light range, as explained previously.

[0059] Referring to Fig.4, the optical pickup 40 includes a light intensity modulator 41 for modulating the intensity of

the laser light from the UV laser light source 1, and an objective lens 42 for converging the laser light on the optical disc 8. The optical pickup also includes a Fresnel zone plate (FZP) 43 for converging the laser light of the visible range on the optical disc 8 in a state free from aberration, and a bi-axial actuator 44 for driving the objective lens 42 in a direction along the optical axis and in a direction normal to the optical axis. The optical pickup finally includes a photodetector 45 for detecting the light reflected by the optical disc 8 and transmitted through the objective lens 42, and an optical system 46 for conducting the transmitted light to the photodetector 45.

[0060] The laser light outgoing from the UV laser light source 1 is sent to a beam splitter 46c via lenses 46a, 46b constituting a portion of an optical system 46. The lens 46a allows the coherent laser light beam with a small beam spot diameter to pass through its focal point and to the lens 46b for setting the beam spot diameter to a pre-set diameter.

5 The lens 46b collimates the light from the lens 46a and sends the collimated light to the beam splitter 46c.

[0061] The beam splitter 46c bends the optical axis of the lens 46b by 90° for directing the laser light towards the optical disc 8. This laser light falls on the light intensity modulator 41.

[0062] The light intensity modulator 41 is an optical element exploiting photo-electrical effects by utilizing changes in refractive index caused by impression of electrical voltage. Alternatively, it is an optical element exploiting acousto-optical effects by utilizing the correlation between the sound wave and the light wave passing through the medium. The light incident on the light intensity modulator 41 is modulated in accordance with the subsidiary information supplied from outside, and a 0'th order light of the modulated light is taken out.

[0063] The laser light from the light intensity modulator 41 is sent to e.g., the biaxial actuator 44 fitted with the FZP 43 and the objective lens 42 as optical components. The biaxial actuator 44 drives the objective lens 42 in a direction indicated by arrows shown in Fig.4, that is in a direction along the optical axis of the objective lens 42 and in a direction normal to the optical axis.

[0064] The FZP 43 is formed of a transparent material exhibiting little absorption in the far-UV range, such as synthesized quartz. The FZP 43 is a concentric phase diffraction lattice formed on the substrate surface. Fig.5 shows the cross-sectional profile of the phase diffraction lattice.

[0065] The FZP 43 is ideally rectangular in cross-sectional shape and has a constant lattice depth without regard to the radial position, as shown in Fig.5. In addition, the FZP 43 has the lattice period changed depending on the radial position from the center towards the outer rim portion, as shown in Fig.5. The principle of the FZP 43 will be elucidated subsequently.

[0066] The optical disc 8 is irradiated via the objective lens 42 with a laser light corrected by the FZP 43 which functions as a lens in the visible light range and which fails to function as a lens in a band of the far-infra-red range.

[0067] The photodetector 45 converts the detected light into electrical signals which are transmitted to the servo circuit 47. The servo circuit 47 finds a signal controlling the operation of the biaxial actuator 44 by the resulting focusing error signals and tracking error signals.

[0068] The biaxial actuator 44 shifts the objective lens 42 in the direction along the optical axis and in the direction normal thereto for minimizing the focusing and tracking errors, as described previously. Thus the optical recording/reproducing apparatus exhibits optimum recording characteristics for the far-UV range. Since the information signals are recorded with optimum recording characteristics, and the focusing and tracking control may be carried out with the light in the visible light range, the information signals can be reproduced with optimum playback characteristics.

[0069] The principle of the FZP 43 is explained.

[0070] It is known that a lens formed of a transparent optical material designed to transmit the light in a defined far-UV range is difficult to use directly for the visible range. For example, if the single lens formed of artificial quartz for the wavelength range of 266 nm is used for the wavelength of 532 nm, the wavelength dispersion of the artificial quartz may be calculated using parameters now to be explained.

[0071] As for the wavelength-dependent parameters, the refractive index N is such that

45

$$\text{refractive index for the wavelength of } 266 \text{ nm } N_{266} = 1.499$$

50

$$\text{refractive index for the wavelength of } 532 \text{ nm } N_{532} = 1.461$$

[0072] The increase in the focal length for the wavelength 532 nm of the single lens, caused by such difference in the refractive index, is obtained from the equation (1):

55

$$(0.499-0.461)/0.499=7.7\% \quad (1)$$

[0073] Thus, with the focal length of 4.5 mm of the single lens for the wavelength of 266 nm, the increase in the focal

length of the single lens for the wavelength of 532 nm is 343 μm . Thus it is seen that a laser light spot with a wavelength of 532 nm is difficult to form on the image plane for the wavelength of 266 nm.

[0074] Thus, if the single lens is to be used for the wavelength of 532 nm, it is possible to form a spot on the same image plane if a thin-walled lens having a focal length equal to the focal length of the single lens divided by 7.7(%), referred to herein as a second lens, is used in intimate contact with the single lens. In effect, given the second lens having a constant thickness, the focal length of the second lens is 60 to 70 mm.

[0075] If the second lens is constituted by the FZP 43 as shown in Fig.5, and the lattice has a pre-set depth t equal to 532 nm, the phase depth ϕ for the wavelength $\lambda = 266 \text{ nm}$ is equal to 2π , as shown by the equation (2):

$$\phi=2\pi(N-1)t/\lambda=2\pi\times0.499\times532/266=2\pi \quad (2)$$

[0076] That is, the diffraction efficiency at the wavelength $\lambda=266 \text{ nm}$ of the FZP 43 becomes minimum such that the FZP fails to function as a lens.

[0077] On the other hand, the phase depth ϕ becomes equal to 0.92π as indicated by the equation (3):

$$\phi=2\pi(N-1)t/\lambda=2\pi\times0.461\times532/532=0.92\pi \quad (3)$$

[0078] That is, in the vicinity of $\phi=\pi$ where the diffraction efficiency becomes maximum, the FZP 43 functions effectively as a lens having a constant focal length.

[0079] Fig.6 shows the relation between the phase depth ϕ , transmittance of the 0'th order light I_0 and the diffraction efficiency of the first-order diffracted light I_1 .

[0080] In Fig.6, arrows 2ω , 4ω in fig.6 represent the positions of the second harmonics having the wavelength of 532 nm and the fourth harmonics having the wavelength of 266 nm, with the wavelength of 1064 nm being that of the fundamental wave. The phase depth $\phi=2\pi$ for the fourth harmonics of the wavelength of 266 nm is naturally equivalent to $\phi=0$.

[0081] If, with the FZP 43 having the focal length f , the radius vector is r and the coefficient is a , the phase depth $\phi(r)$ of the wave surface is given by the equation (4):

$$\phi(r)=ar^2 \quad (4)$$

[0082] The phase depth $\phi(r)$ of the FZP 43 is set to 0 and ϕ for the range shown in the equation (5):

$$2m\pi-\pi/2 < \phi(r) < 2m\pi+\pi/2 \quad (5)$$

and otherwise, respectively, where m is a natural number.

[0083] The relation between the coefficient a and the focal length f is represented by the equation (6):

$$a=\pi/\lambda f \quad (6)$$

[0084] For preparing the FZP 43 with the focal length $f=65 \text{ mm}$ for the wavelength $\lambda=532 \text{ nm}$, it suffices to set so that $a=28.92\pi$ from the equation (6).

[0085] For producing the FZP 43 having the focal length $f=65 \text{ mm}$, for example, for the wavelength $\lambda=532 \text{ nm}$, it suffices to set $a=28.92\pi$ from the equation (6).

[0086] With a lens construction comprised of the objective lens 42 having no aberration for the wavelength $\lambda=532 \text{ nm}$, the spherical aberration produced on using the lens construction for the wavelength $\lambda=532 \text{ nm}$ is represented by the equation (7):

$$\exp\{-i2\pi(N-1)(AR^4+BR^6)/\lambda\} \quad (7)$$

[0087] The coefficients A and B in the equation (7) are fourth-order and sixth-order coefficients of spherical aberration on polynomial expansion of the spherical aberration. These coefficients of spherical aberration may be calculated using

a general-purpose optical design program.

[0088] The phase depth $\phi(r)$ of the wave surface represented by the equation (4) may be modified as shown in the equation (8):

5

$$\phi(r)=ar^2-2\pi(N-1)(Ar^4+Br^6)/\lambda \quad (8)$$

10

[0089] Specifically, since the amount of the spherical aberration in the vicinity of the pupil for the numerical aperture of the objective lens 42 of 0.4 is on the order of 3λ , the FZP 43 can be satisfactorily fabricated by correcting the spherical aberration represented by the equation (7).

15

[0090] The relation of $\phi(r)$ with respect to the radius vector r may be represented by a broken line specifying the absence of aberration and a solid line representing the post-correction state. It is seen from Fig.7 that the amount of correction is increased outwardly from $r=1$ mm as shown for example in Fig.7.

[0091] An aspherical lens with the numerical aperture of 0.4, which should be corrected by the FZP 43, is represented as shown for example in Fig.8. The design dimensions of the aspherical lens are as shown in Table 1. It is noted that the focal length and the residual wave front aberration for the wavelength $\lambda=266$ nm are also shown in Fig.8.

TABLE 1

	radius of curvature	thickness	refractive index	aspherical coefficient
article surface	∞	∞		
first surface	2.50144	2.500000	1.499679 (synthetic quartz)	K:-0.177604 A:-0.208109E -02 B:-0.244232E -03 C: 0.000000E +00 D: 0.000000E +00
second surface	-14.83532	3.001502	1 (air)	K:-175. 128050 A:-0.166 201E-02 B:-0.103 811E+00 C: 0.000000 E-00 D: 0.000000 E+00
image surface	∞	-0.00006		
focal length: 45 mm ($\lambda=266$ nm) 4.8675 ($\lambda=532$ nm) wave front aberration on axis: 0.006 rms λ wave front aberration outside axis: 0.016 rms λ				

40

[0092] Figs.9A and 9B show the residual wave front aberration on allowing the laser light with the wavelength $\lambda=532$ nm to fall on the objective lens 42, with the numerical aperture of 0.4, as corrected with the FZP 43. In these figures, the abscissa denotes the relative pupil coordinate of the lens and the ordinate denotes the wave front aberration with the full scale being one wavelength.

45

[0093] Figs.9A and 9B show aberration characteristics in the tangential direction with the image height being 40 μm , and aberration characteristics in the sagittal direction with the image height being 40 μm , respectively. On the other hand, Figs.9C and 9D show on-axis aberration characteristics in the tangential direction and on-axis aberration characteristics in the sagittal direction, respectively.

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[0094] The rms spherical aberration is 0.002 λ and 0.029 λ on the axis and with the image height of 4040 μm , respectively. These values are satisfactory as characteristics of the optical recording/reproducing apparatus. Before correction of the spherical aberration, the rms spherical aberration is not less than 0.07 λ if the numerical aperture is diminished to 0.3.

55

[0095] By constructing the FZP 43 as described previously, it may function as a lens in the visible light range, while failing to function as a lens in the far-UV range. Since deterioration in the visible light range in the characteristics of the lens designed for far-UV light may be compensated in this manner, focusing error and tracking error signals may be obtained using the photodetector 45 by correction in the visible light range without deteriorating light condensing

characteristics in the far-UV range, so that sufficient recording characteristics may be achieved for recording. The subsidiary information for identification of each optical recording medium is recorded on the optical recording medium, so that it can be decided easily whether or not the optical recording medium has been duplicated illicitly, thus prohibiting the optical recording medium from being duplicated illicitly.

- 5 [0096] The wavelength of the UV laser light is 190 to 370 nm which is appropriate for machining the recording medium thus facilitating recording of the identification information on the optical recording medium.
- [0097] The identification information is recorded in the subsidiary information recording area in the same configuration as that of the substantial information recorded in the information recording area and may be read out easily using an optical pickup as reading means configured for reading out the substantial information.
- 10 [0098] Since the subsidiary information is the identification information proper to each recording medium, it becomes possible to identify each optical recording medium.
- [0099] By recording the identification information on the optical recording medium using the pre-recorded guide pattern for tracking, the identification information may be recorded correctly on the optical recording medium, while the recorded identification information may be read out correctly.
- 15 [0100] Since the guide pattern may be detected using the light of a wavelength different from the wavelength of the laser light, tracking error signals can be detected promptly and accurately, while the identification information may be recorded at a precise position.

20 **Claims**

1. An optical recording method for recording identification information on an optical recording medium (8), whereby said identification information identifies said optical recording medium and is different from substantial information recorded in an information recording area (50) of said optical recording medium and is recorded in an area (51) different from said information recording area (50),
25 characterized by
the steps of generating a UV laser light of a wavelength absorbed by the substrate of said optical recording medium (8) and radiating said UV laser light; and modulating the intensity of said UV laser light for recording said identification information as pits of the substrate within said area (51) in a configuration enabling a reproduction of said identification information with an optical pickup being configured for reproducing said substantial information.
2. The optical recording method as claimed in claim 1 wherein said UV laser light has a wavelength of 190 to 370 nm.
3. The optical recording method as claimed in claim 1 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a neodymium YAG (Nd:YAG) laser.
- 35 4. The optical recording method as claimed in claim 1 wherein said identification information is recorded in said optical recording medium using a pre-recorded guide pattern for tracking.
5. The optical recording method as claimed in claim 4 wherein said guide pattern is detected using the light having a wavelength different from that of the UV laser light when tracking is done using said guide pattern.
- 40 6. The optical recording method as claimed in claim 1 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a Nd:YVO₄ laser.
7. The optical recording method as claimed in claim 1 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a Nd:YLF laser.
- 45 8. The optical recording method as claimed in claim 1 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a Nd:YAP laser.
9. The optical recording method as claimed in claim 1 wherein said UV laser light is generated from laser light of a wavelength of 0,78 to 0,86 µm from an AlGaAs laser.
- 50 10. The optical recording method as claimed in claim 1 wherein said UV laser light is generated from laser light of a wavelength of 0,9 to 1,1 µm from an INGaAs laser.
11. The optical recording method as claimed in claim 1 wherein said UV laser light is the laser light from an Ar laser.

12. The optical recording method as claimed in claim 1 wherein said UV laser light is the laser light from an He-Cd laser.

13. An optical recording apparatus for recording identification information on an optical recording medium (8), comprising:

5 a laser light source (1) for generating a UV laser light of a wavelength absorbed by the substrate said optical recording medium (8) and radiating said UV laser light;
 modulating means (2, 41) for modulating the intensity of the UV laser light from said laser light source (1);
 10 spot position control means (7, 44) for being moved on said optical recording medium (8) for deciding the position of a spot of the UV light beam converged on said optical recording medium (8); and
 scanning means (47) for scanning said optical recording medium with said spot;

wherein

15 said identification information identifies said optical recording medium and is different from substantial information recorded in an information recording area (50) of said optical recording medium and is recorded in an area (51) different from said information recording area (50), and said modulating means (2, 41) modulates the intensity of the UV laser light so that said identification information is recorded as pits of the substrate within said area (51) in a configuration enabling a reproduction of said identification information with an optical pickup being configured for reproducing said substantial information.

20 14. The optical recording apparatus as claimed in claim 13 wherein said UV laser light has a wavelength of 190 to 370 nm.

25 15. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a neodymium YAG (Nd:YAG) laser.

16. The optical recording apparatus as claimed in claim 13 wherein said identification information is recorded in said optical recording medium (8) using a pre-recorded guide pattern for tracking.

30 17. The optical recording apparatus as claimed in claim 16 wherein said guide pattern is detected using the light having a wavelength different from that of the UV laser light when tracking is done using said guide pattern.

18. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a Nd:YVO₄ laser.

35 19. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a Nd:YLF laser.

20. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is the far-ultraviolet laser light generated by fourth harmonics generation of a Nd:YAP laser.

40 21. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is generated from laser light from an AlGaAs laser.

45 22. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is generated from laser light from an INGaAs laser.

23. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is the laser light from an Ar laser.

50 24. The optical recording apparatus as claimed in claim 13 wherein said UV laser light is the laser light from a He-Cd laser.

25. An optical recording medium (8), comprising:

55 an information recording area (50) having substantial information composed of audio data, video data or character data recorded thereon; and

an identification information recording area (51) different from said information recording area (50) and having identification information different from said substantial information which identification information identifies

said optical recording medium (8) recorded thereon;

characterized in that said identification information is recorded as pits of the substrate within said identification information recording area (51) in a configuration enabling a reproduction of said identification information with an optical pickup being configured for reproducing said substantial information.

5 26. The optical recording medium as claimed in claim 25 wherein a guide groove for tracking is pre-recorded in said identification information recording area and wherein said identification information is recorded using said guide pattern.

10 27. The optical recording medium as claimed in claim 26 wherein, if tracking is done using said guide pattern, said guide pattern is detected using the light of a wavelength different from the wavelength of said UV laser light.

15 28. The optical recording medium as claimed in claim 25 wherein said identification information is composed of codes or micro-codes.

Patentansprüche

20 1. Optisches Aufzeichnungsverfahren zum Aufzeichnen einer Identifikationsinformation auf einem optischen Aufzeichnungsträger (8), wobei die Identifikationsinformation den optischen Aufzeichnungsträger identifiziert und gegenüber der substantiellen Information, die auf einem Informationsaufzeichnungsbereich (50) des optischen Aufzeichnungsträgers aufgezeichnet ist, verschieden ist, und auf einem Bereich (51) aufgezeichnet ist, der gegenüber dem Informationsaufzeichnungsbereich (50) verschieden ist,

25 gekennzeichnet durch
die Schritte zum Erzeugen eines UV-Laserlichts einer Wellenlänge, die durch das Substrat des optischen Aufzeichnungsträgers (8) absorbiert wird, und zum Abstrahlen des UV-Laserlichts; und zum Modulieren der Intensität des UV-Laserlichts, um die Identifikationsinformation als Pits des Substrats innerhalb des Bereichs (51) in einer Konfiguration aufzuzeichnen, die eine Wiedergabe der Identifikationsinformation mit einer optischen Abtasteinrichtung ermöglicht, die ausgebildet ist, die substantielle Information wiederzugeben.

30 2. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht eine Wellenlänge von 190 bis 370 nm hat.

35 3. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei, das UV-Laserlicht ein fern-ultraviolettes Laserlicht ist, welches durch Erzeugung von vierten Harmonischen eines Neodym-YAG-Lasers (Nd:YAG) erzeugt wird.

40 4. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei die Identifikationsinformation auf dem optischen Aufzeichnungsträger aufgezeichnet wird, wobei ein vorher-aufgezeichnetes Führungsmuster zur Spurnachführung verwendet wird.

45 5. Optisches Aufzeichnungsverfahren nach Anspruch 4, wobei das Führungsmuster dadurch ermittelt wird, daß das Licht verwendet wird, welches eine Wellenlänge hat, die sich von der des UV-Laserlichts unterscheidet, wenn das Spurnachführen durchgeführt wird, wobei das Führungsmuster verwendet wird.

6. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht ein fern-ultraviolettes Laserlicht ist, welches durch Erzeugung von vierten Harmonischen eines Nd:YVO₄-Lasers erzeugt wird.

50 7. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht ein fern-ultraviolettes Laserlicht ist, welches durch Erzeugung von vierten Harmonischen eines Nd:YLF-Lasers erzeugt wird.

8. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht ein fern-ultraviolettes Laserlicht ist, welches durch Erzeugung von vierten Harmonischen eines Nd:YAP-Lasers erzeugt wird.

55 9. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht von einem Laserlicht einer Wellenlänge von 0,78 bis 0,86 µm von einem AlGaAs-Laser erzeugt wird.

10. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht von einem Laserlicht einer Wellen-

länge von 0,9 bis 1,1 µm von einem INGaAs-Laser erzeugt wird.

11. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht das Laserlicht von einem Ar-Laser ist.

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12. Optisches Aufzeichnungsverfahren nach Anspruch 1, wobei das UV-Laserlicht das Laserlicht von einem He-Cd-Laser ist.

10

13. Optisches Aufzeichnungsverfahren zum Aufzeichnen einer Identifikationsinformation auf einem optischen Aufzeichnungsträger (8), welches umfaßt:

eine Laserlichtquelle (1), um ein UV-Laserlicht einer Wellenlänge zu erzeugen, die durch das Substrat, des optischen Aufzeichnungsträgers (8) absorbiert wird, und um das UV-Laserlicht abzustrahlen;

15

eine Modulationseinrichtung (2, 41), um die Intensität des UV-Laserlichts von der Laserlichtquelle (1) zu modulieren;

eine Fleckpositions-Steuereinrichtung (7, 44), die auf dem optischen Aufzeichnungsträger (8) verschoben wird, um die Position eines Flecks des UV-Lichtstrahls zu bestimmen, der auf den optischen Aufzeichnungsträger (8) gebündelt ist; und

20

eine Abtasteinrichtung (47), um den optischen Aufzeichnungsträger mit dem Fleck abzutasten; wobei die Identifikationsinformation den optischen Aufzeichnungsträger identifiziert und gegenüber der substantiellen Information verschieden ist, die auf einem Informationsaufzeichnungsbereich (50) des optischen Aufzeichnungsträgers aufgezeichnet ist, und die auf einem Bereich (51) aufgezeichnet ist, der gegenüber dem Informationsaufzeichnungsbereich (50) verschieden ist, und die Modulationseinrichtung (2, 41) die Intensität des UV-Laserlichts so moduliert, daß die Identifikationsinformation als Pits des Substrats innerhalb des Bereichs (51) in einer Konfiguration aufgezeichnet ist, die eine Wiedergabe der Identifikationsinformation mit einer optischen Abtasteinrichtung ermöglicht, die konfiguriert ist, die substantielle Information wiederzugeben.

25

14. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht eine Wellenlänge von 190 bis 370 nm hat.

30

15. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht ein fern-ultraviolettes Laserlicht ist, welches durch Erzeugung von vierten Harmonischen, eines Neodym-YAG-Lasers (Nd:YAG) erzeugt wird.

35

16. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei die Identifikationsinformation auf dem optischen Aufzeichnungsträger (8) aufgezeichnet ist, wobei ein vorheraufgezeichnetes Führungsmuster zur Spurnachführung verwendet wird.

40

17. Optisches Aufzeichnungsgerät nach Anspruch 16, wobei das Führungsmuster dadurch ermittelt wird, daß das Licht verwendet wird, welches eine Wellenlänge hat, die sich von der des UV-Laserlichts unterscheidet, wenn das Spurnachführen unter Verwendung des Führungsmusters durchgeführt wird.

50

18. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht das fern-ultraviolettes Laserlicht ist, welches durch Erzeugung von vierten Harmonischen eines Nd:YVO₄-Lasers erzeugt wird.

45

19. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht das fern-ultraviolettes Laserlicht ist, welches durch Erzeugung von vierten Harmonischen eines Nd:YLF-Lasers erzeugt wird.

20. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht das ultraviolette Fern-Laserlicht ist, welches durch Erzeugung von vierten Harmonischen eines Nd:YAP-Lasers erzeugt wird.

55

21. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht von einem Laserlicht von einem Al-GaAs-Laser erzeugt wird.

22. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht von einem Laserlicht von einem IN-GaAs-Laser erzeugt wird.

23. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht das Laserlicht von einem Ar-Laser ist.

24. Optisches Aufzeichnungsgerät nach Anspruch 13, wobei das UV-Laserlicht das Laserlicht von einem He-Cd-Laser ist.

25. Optischer Aufzeichnungsträger (8), der umfaßt:

5 einen Informationsaufzeichnungsbereich (50), auf welchem substantielle Information, die aus Audiodaten, Videodaten oder Zeichendaten besteht, aufgezeichnet ist; und

10 einen Identifikationsinformations-Aufzeichnungsbereich (51), der vom Informationsaufzeichnungsbereich (50) verschieden ist, auf dem eine Identifikationsinformation, die von der substantiellen Information verschieden ist, die die Identifikationsinformation des optischen Aufzeichnungsträgers (8) identifiziert, aufgezeichnet ist;

15 dadurch gekennzeichnet, daß die Identifikationsinformation als Pits des Substrats innerhalb des Identifikationsinformations-Aufzeichnungsbereichs (51) in einer Konfiguration aufgezeichnet ist, die eine Wiedergabe der Identifikationsinformation mit einer optischen Abtasteinrichtung ermöglicht, die konfiguriert ist, die substantielle Information wiederzugeben.

20 26. Optischer Aufzeichnungsträger nach Anspruch 25, wobei eine Führungsnot zum Spurnachführen vorher im Identifikationsinformations-Aufzeichnungsbereich aufgezeichnet ist und wobei die Identifikationsinformation unter Verwendung des Führungsmusters aufgezeichnet ist.

25 27. Optischer Aufzeichnungsträger nach Anspruch 26, wobei, wenn das Spurnachführen unter Verwendung des Führungsmusters durchgeführt wird, das Führungsmuster unter Verwendung des Lichts einer Wellenlänge ermittelt wird, die von der Wellenlänge des UV-Laserlichts verschieden ist.

28. Optischer Aufzeichnungsträger nach Anspruch 25, wobei die Identifikationsinformation aus Codes oder Mikro-Codes besteht.

Revendications

30 1. Procédé d'enregistrement optique destiné à enregistrer des informations d'identification sur un support d'enregistrement optique (8), d'où il résulte que lesdites informations d'identification identifient ledit support d'enregistrement optique et sont différentes des informations principales enregistrées dans une zone d'enregistrement d'informations (50) dudit support d'enregistrement optique et sont enregistrées dans une zone (51) différente de ladite zone d'enregistrement d'informations (50),

35 caractérisé par

les étapes consistant à générer une lumière laser ultraviolette d'une longueur d'onde absorbée par le substrat dudit support d'enregistrement optique (8) et faire rayonner ladite lumière laser ultraviolette, et moduler l'intensité de ladite lumière ultraviolette destinée à l'enregistrement desdites informations d'identification sous forme de microcuvettes du substrat à l'intérieur de ladite zone (51) suivant une configuration permettant une reproduction desdites informations d'identification, une tête de lecture optique étant configurée pour reproduire lesdites informations principales.

40 2. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette présente une longueur d'onde de 190 à 370 nm.

45 3. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser au grenat d'yttrium et d'aluminium dopé au néodyme (Nd:YAG).

50 4. Procédé d'enregistrement optique selon la revendication 1 dans lequel lesdites informations d'identification sont enregistrées dans ledit support d'enregistrement optique en utilisant un motif de guidage préenregistré en vue du suivi de piste.

55 5. Procédé d'enregistrement optique selon la revendication 4 dans lequel ledit motif de guidage est détecté en utilisant de la lumière présentant une longueur d'onde différente de celle de la lumière laser ultraviolette lorsqu'un suivi de piste est réalisé en utilisant ledit motif de guidage.

6. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser Nd:YVO₄.

5 7. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser Nd:YLF.

8. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser Nd:YAP.

10 9. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette est générée à partir d'une lumière laser d'une longueur d'onde de 0,78 à 0,86 µm provenant d'un laser AlGaAs.

15 10. Procédé d'enregistrement optique selon la revendication 1, dans lequel ladite lumière laser ultraviolette est générée à partir d'une lumière laser d'une longueur d'onde de 0,9 à 1,1 µm provenant d'un laser InGaAs.

11. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette est une lumière laser provenant d'un laser Ar.

20 12. Procédé d'enregistrement optique selon la revendication 1 dans lequel ladite lumière laser ultraviolette est une lumière laser provenant d'un laser He-Cd.

13. Appareil d'enregistrement optique destiné à enregistrer des informations d'identification sur un support d'enregistrement optique (8), comprenant,

25 une source de lumière laser (1) destinée à générer une lumière laser ultraviolette d'une longueur d'onde absorbée par le substrat dudit support d'enregistrement optique (8) et à rayonner ladite lumière laser ultraviolette, un moyen de modulation (2, 41) destiné à moduler l'intensité de la lumière laser ultraviolette provenant de ladite source de lumière laser (1),

30 un moyen de commande de position de trace (7, 44) destiné à être déplacé sur ledit support d'enregistrement optique (8) en vue de déterminer la position d'une trace du faisceau de lumière ultraviolette amené à converger sur ledit support d'enregistrement optique (8), et

35 un moyen de balayage (47) destiné à balayer ledit support d'enregistrement optique avec ladite trace, dans lequel lesdites informations d'identification identifient ledit support d'enregistrement optique et sont différentes des informations principales enregistrées dans une zone d'enregistrement d'informations (50) dudit support d'enregistrement optique et sont enregistrées dans une zone (51) différente de ladite zone d'enregistrement d'informations (50), et ledit moyen de modulation (2, 41) module l'intensité de la lumière laser ultraviolette de sorte que lesdites informations d'identification sont enregistrées sous forme de microcuvettes du substrat à l'intérieur de ladite zone (51) suivant une configuration permettant une reproduction desdites informations d'identification, une tête de lecture optique étant configurée pour reproduire lesdites informations principales.

40 14. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette présente une longueur d'onde de 190 à 370 nm.

45 15. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser au grenat d'yttrium et d'aluminium dopé au néodyme (Nd:YAG).

50 16. Appareil d'enregistrement optique selon la revendication 13 dans lequel lesdites informations d'identification sont enregistrées dans ledit support d'enregistrement optique (8) en utilisant un motif de guidage préenregistré en vue du suivi de piste.

55 17. Appareil d'enregistrement optique selon la revendication 16 dans lequel ledit motif de guidage est détecté en utilisant de la lumière présentant une longueur d'onde différente de celle de la lumière laser ultraviolette lorsqu'un suivi de piste est réalisé en utilisant ledit motif de guidage.

18. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser Nd:YVO₄.

19. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser Nd:YLF.

5 20. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est une lumière laser en ultraviolet lointain générée par une génération de quatrièmes harmoniques d'un laser Nd:YAP.

21. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est générée à partir d'une lumière laser provenant d'un laser AlGaAs.

10 22. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est générée à partir d'une lumière laser provenant d'un laser InGaAs.

23. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est une lumière laser provenant d'un laser Ar.

15 24. Appareil d'enregistrement optique selon la revendication 13 dans lequel ladite lumière laser ultraviolette est une lumière laser provenant d'un laser He-Cd.

25. Support d'enregistrement optique (8), comprenant:

20 une zone d'enregistrement d'informations (50) comportant des informations principales composées de données audio, de données vidéo ou bien de données de caractères enregistrées sur celles-ci, et une zone d'enregistrement d'informations d'identification (51) différente de ladite zone d'enregistrement d'informations (50) et comportant des informations d'identification différentes desdites informations principales, lesquelles informations d'identification identifient ledit support d'enregistrement optique (8), enregistrées sur celle-ci,

25 caractérisé en ce que lesdites informations d'identification sont enregistrées sous forme de microcuvettes du substrat à l'intérieur de ladite zone d'enregistrement d'informations d'identification (51) suivant une configuration permettant une reproduction desdites informations d'identification, une tête de lecture optique étant configurée pour reproduire lesdites informations principales.

30 26. Support d'enregistrement optique selon la revendication 25 dans lequel un sillon de guidage destiné à un suivi de piste est préenregistré dans ladite zone d'enregistrement d'informations d'identification et dans lequel lesdites informations d'identification sont enregistrées en utilisant ledit motif de guidage.

35 27. Support d'enregistrement optique selon la revendication 26 dans lequel, si un suivi de piste est réalisé en utilisant ledit motif de guidage, ledit motif de guidage est détecté en utilisant de la lumière d'une longueur d'onde différente de la longueur d'onde de ladite lumière laser ultraviolette.

40 28. Support d'enregistrement optique selon la revendication 25 dans lequel lesdites informations d'identification sont composées de codes ou de microcodes.

45

50

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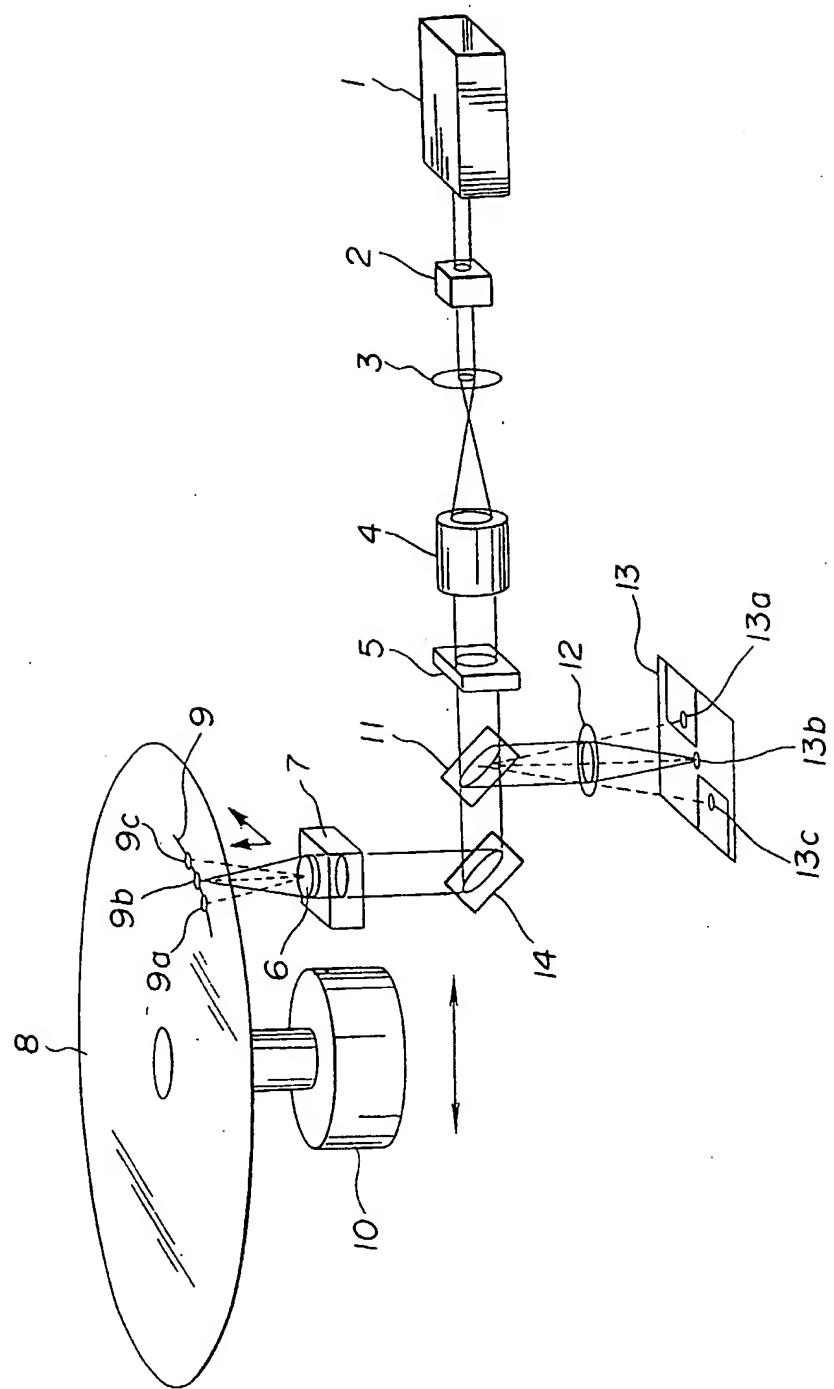


FIG. 1

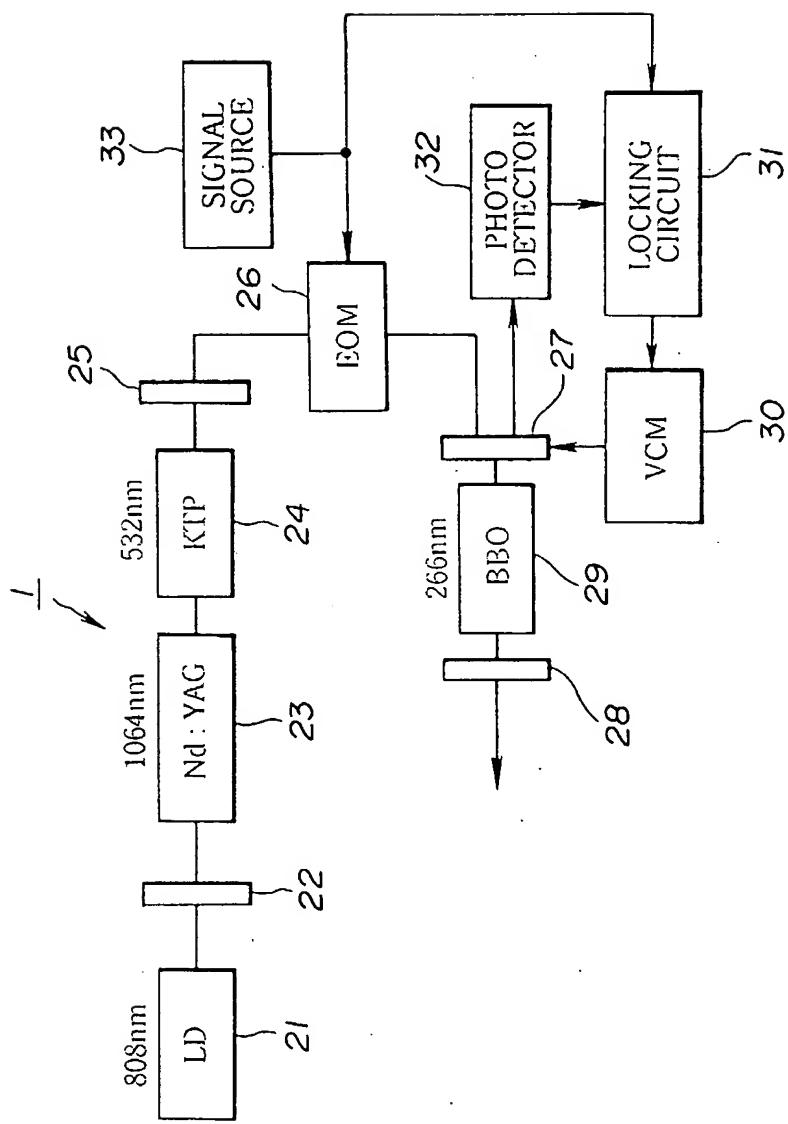


FIG.2

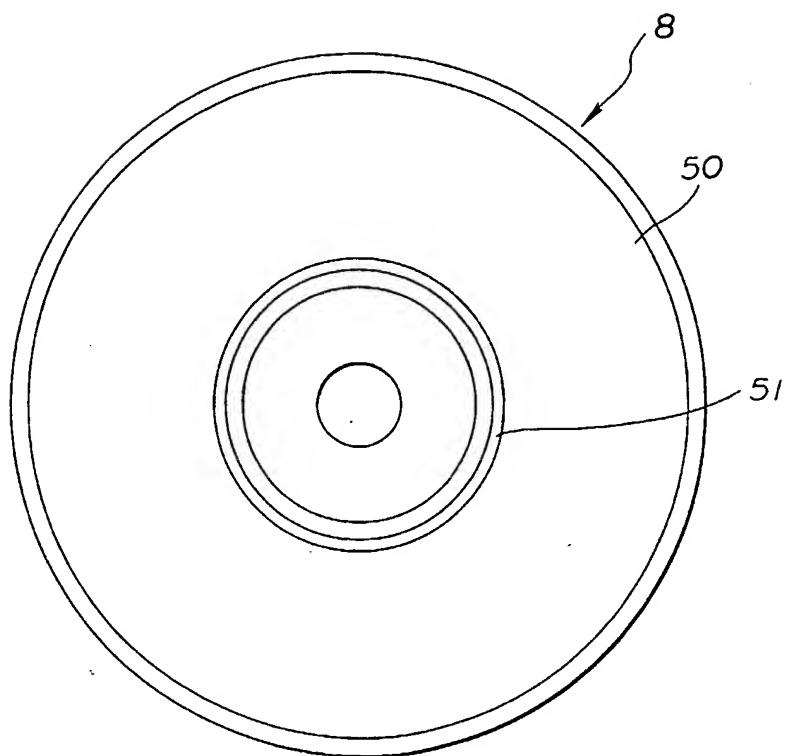


FIG.3

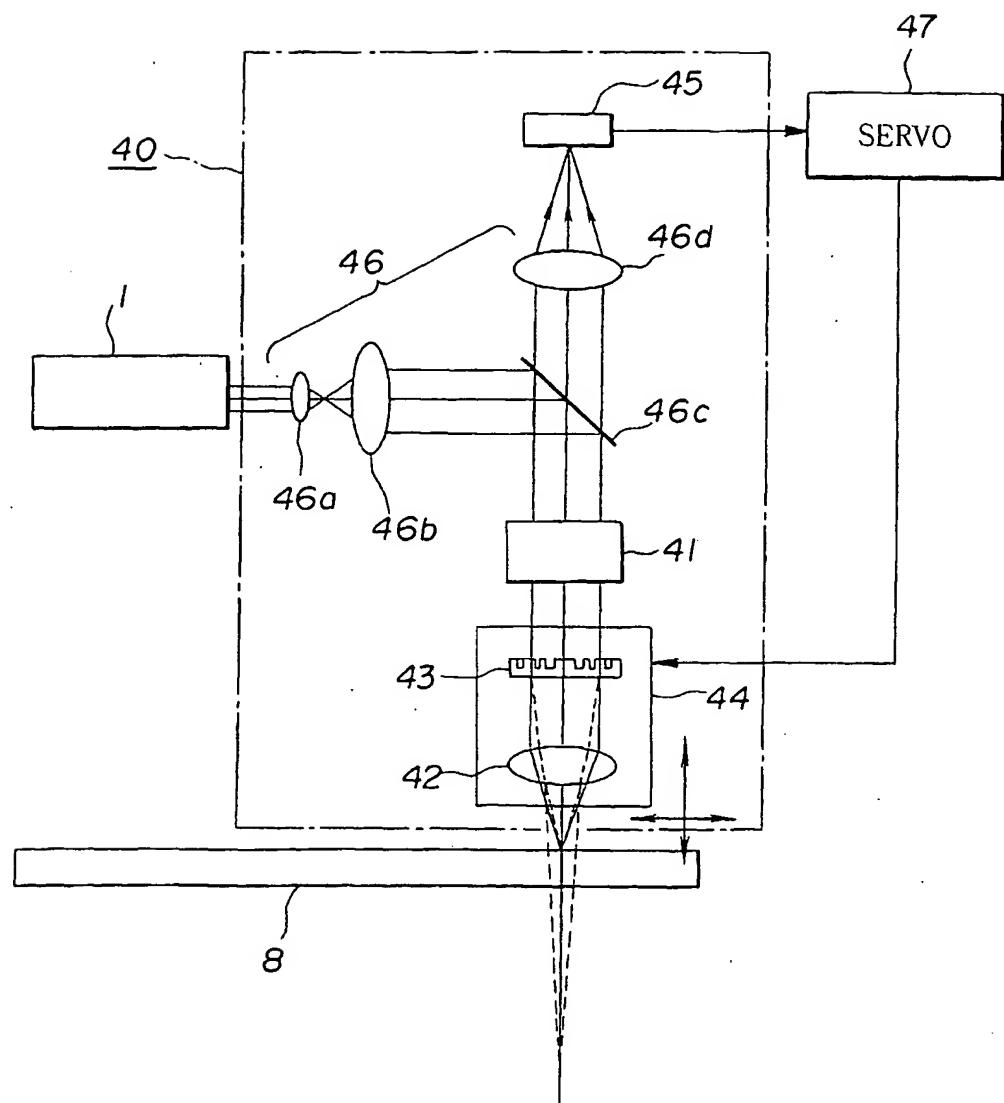


FIG.4

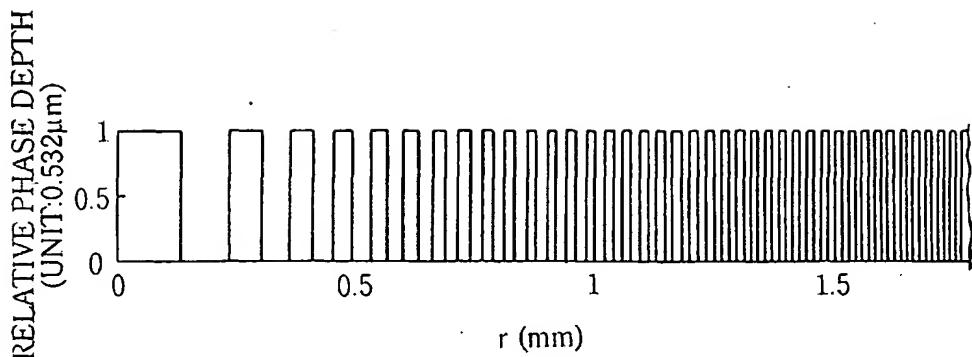


FIG. 5

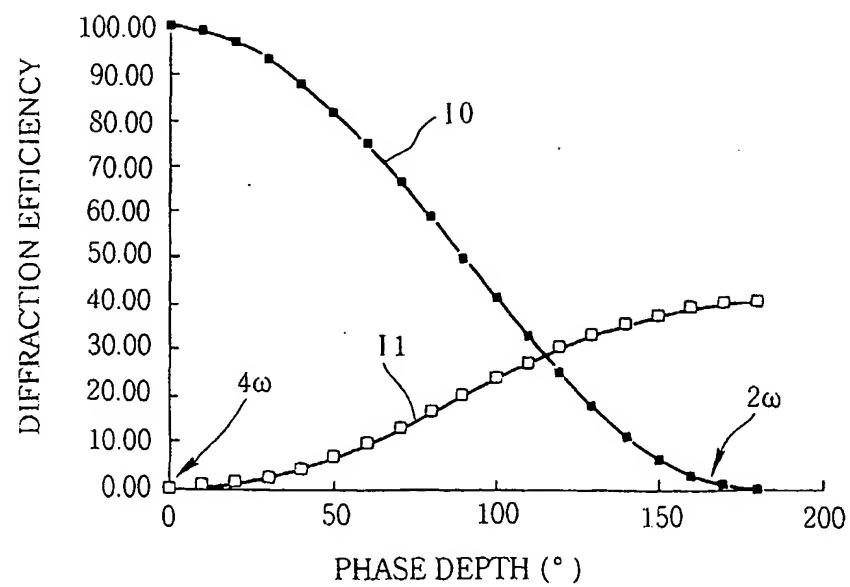


FIG. 6

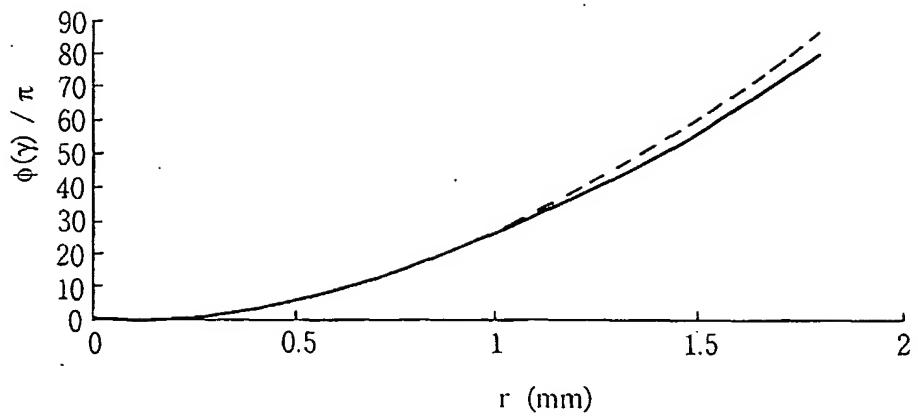


FIG.7

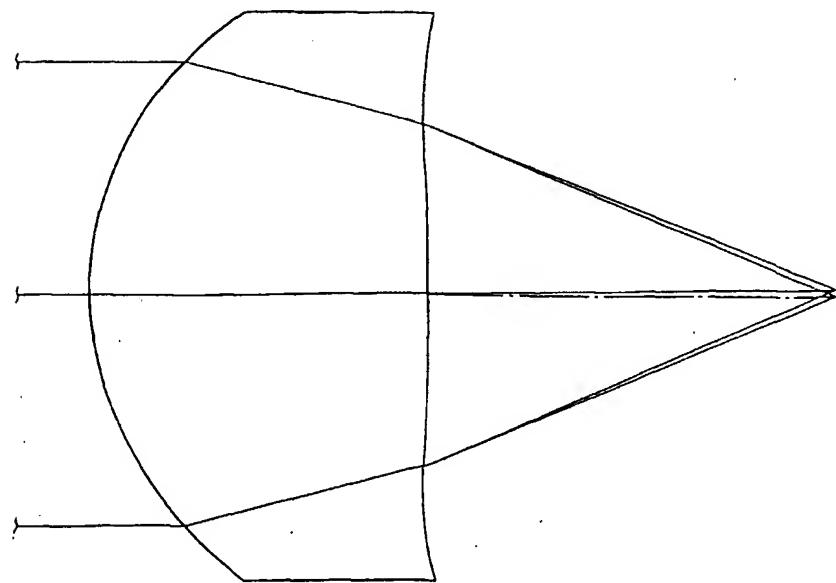


FIG.8

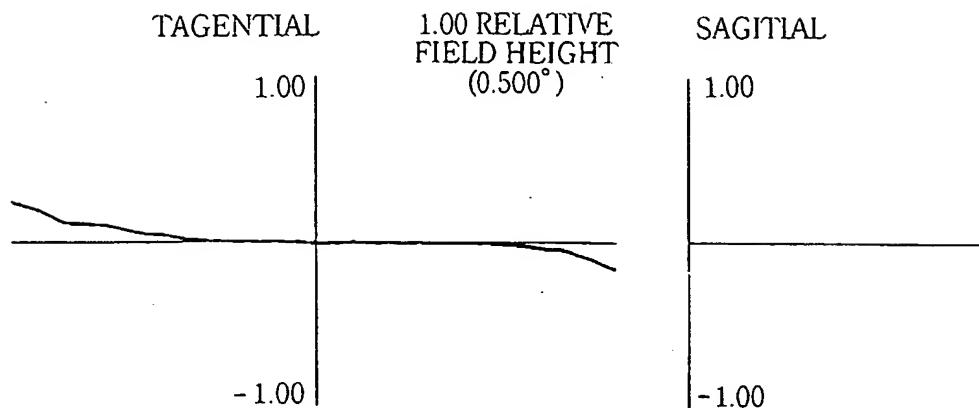


FIG.9A

FIG.9B

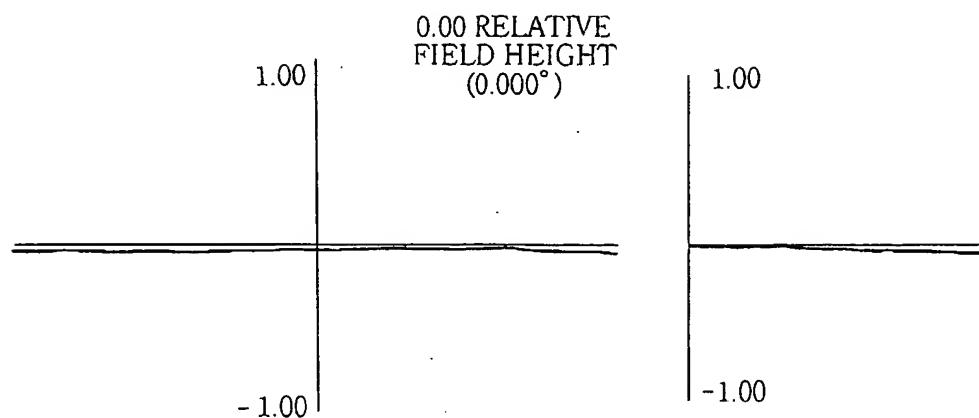


FIG.9C

FIG.9D